

# Illinois Storage Corridor

DE-FE0031892

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University of Illinois

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U.S. Department of Energy

National Energy Technology Laboratory

2021 Carbon Management and Oil and Gas Research Project Review Meeting

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# Presentation Outline

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- Project Overview
- Site Characterization
- Drilling
- Modeling
- UIC Class VI Permitting
- Carbon Capture Assessment
- Summary

# Illinois Storage Corridor CarbonSAFE Phase 3

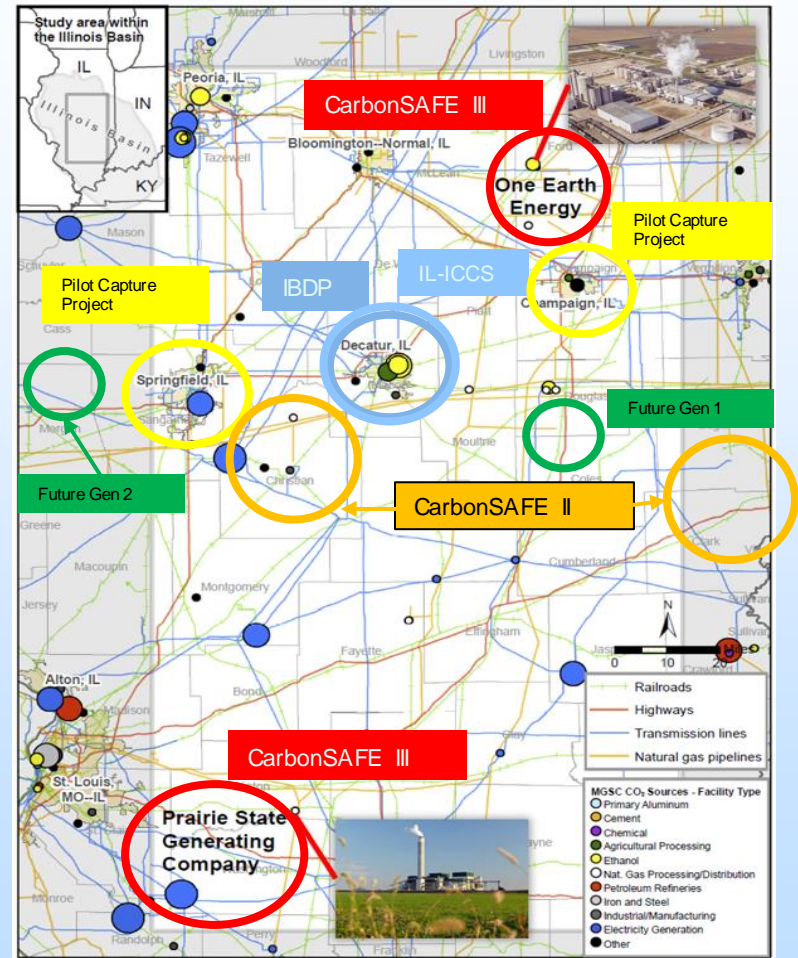
Illinois Storage Corridor is a region with significant previous CCS-related activity

Project builds upon IBDP, CarbonSAFE Phases I and 2 and many other studies.

2 separate sites will be investigated in different storage complexes

Ethanol source: Mt Simon Storage Complex – Storage HUB (0.5 to 1.7 MTPA CO<sub>2</sub>)

Coal-fired power source: FEED study for capture +6 million tons CO<sub>2</sub> per year



# Storage Development

SYSTEM	GROUP	FORMATION	Storage Elements	
Ordovician	Maquoketa	Brainard	Seal	
		Ft. Atkinson		
		Scales		
	Galena	Kimmswick		
		Decorah		
	Platteville			
	Ancell	Joachim		
		St. Peter	Reservoir	
	Cambrian	Knox	Shakopee	Reservoir/ Seal
			New Richmond	
Oneota				
Gunter				
Eminence			Reservoir	
Potosi				
Franconia				
Ironton-Galesville				
Eau Claire		Seal		
Potsdam	Mt. Simon	Reservoir		
Precambrian				

St. Peter-Knox Storage Complex

Cambro-Ordovician Storage Complex



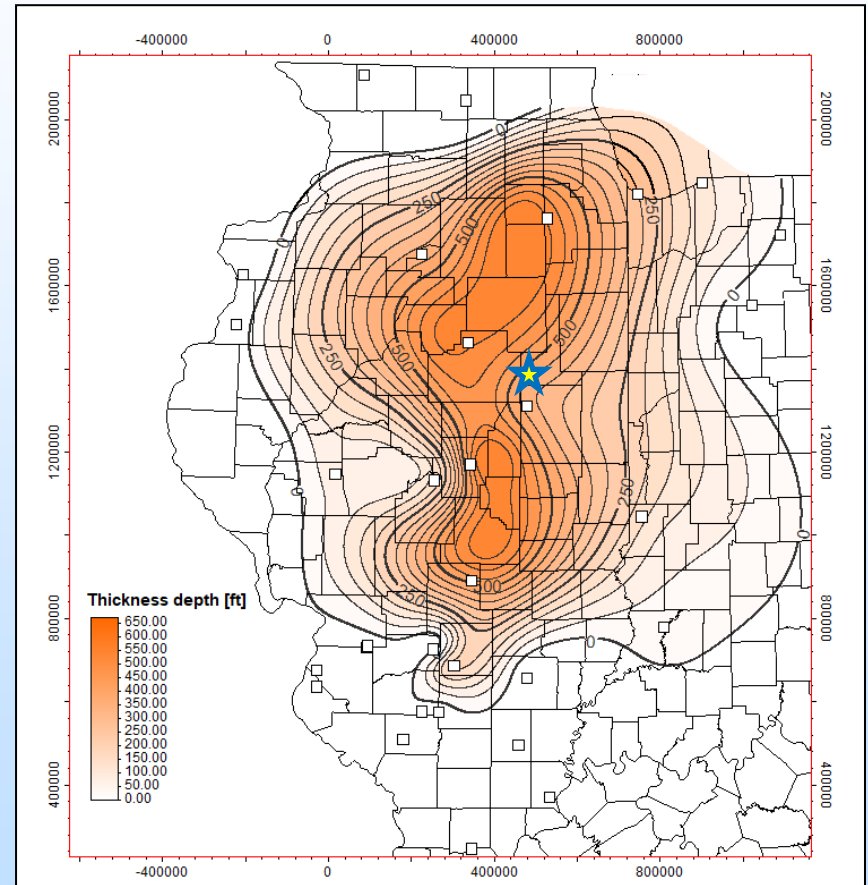
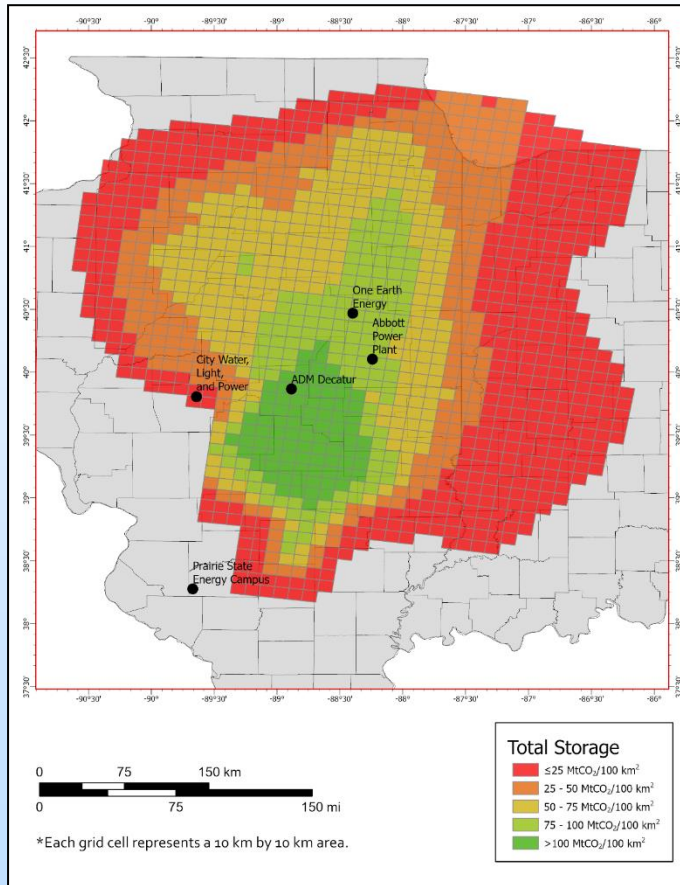
Prairie State – coal fired power station  
commissioned 2012 1600 MW – 2 units  
St Peter Storage Complex (ca 6 MTPA CO<sub>2</sub> from 1 unit)  
Storage near site location



One Earth Energy – ethanol plant  
Mt Simon Storage Complex – Storage HUB (0.45 to 1.7 MTPA CO<sub>2</sub>)  
Storage near site location

# Lower Mt Simon Complex

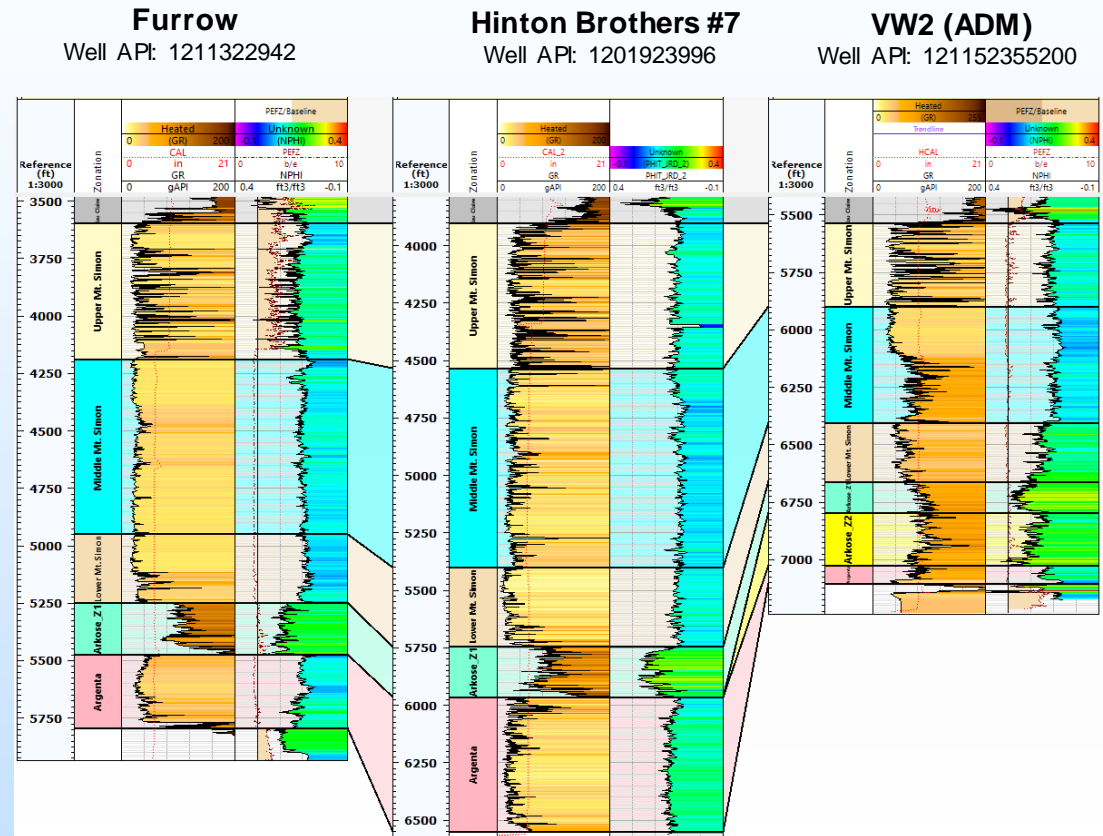
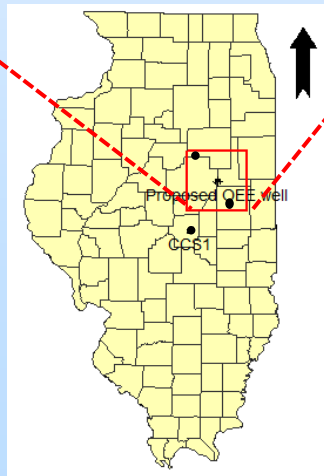
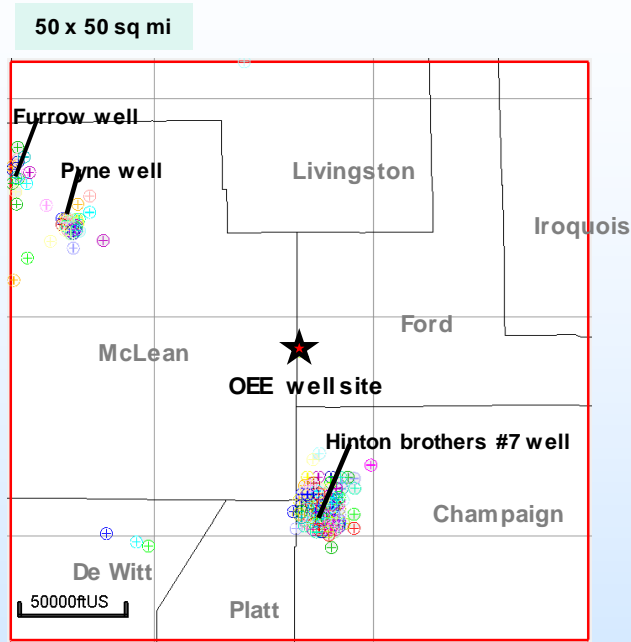
## Sim CCS Gateway



Estimates created using the Sequestration of CO<sub>2</sub> Tool (SCO<sub>2</sub>T)  
Phase 2 CarbonSAFE Macon County DE-FE0029381

Lower Mt Simon Sandstone net thickness (10% porosity cutoff)

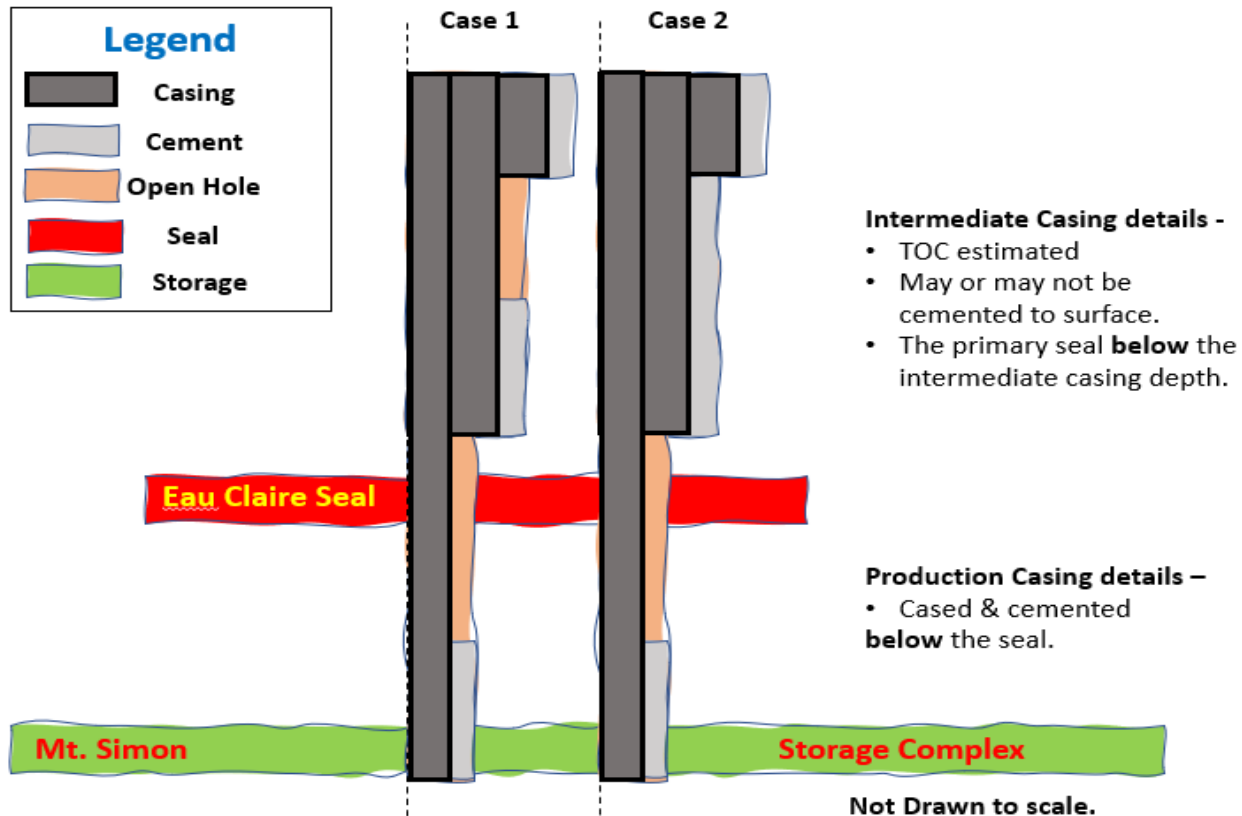
# Static Model Framework





# Legacy Well Identification and Evaluation

**Surface Casing :** Assumed to be cemented to surface if TOC is not specified.

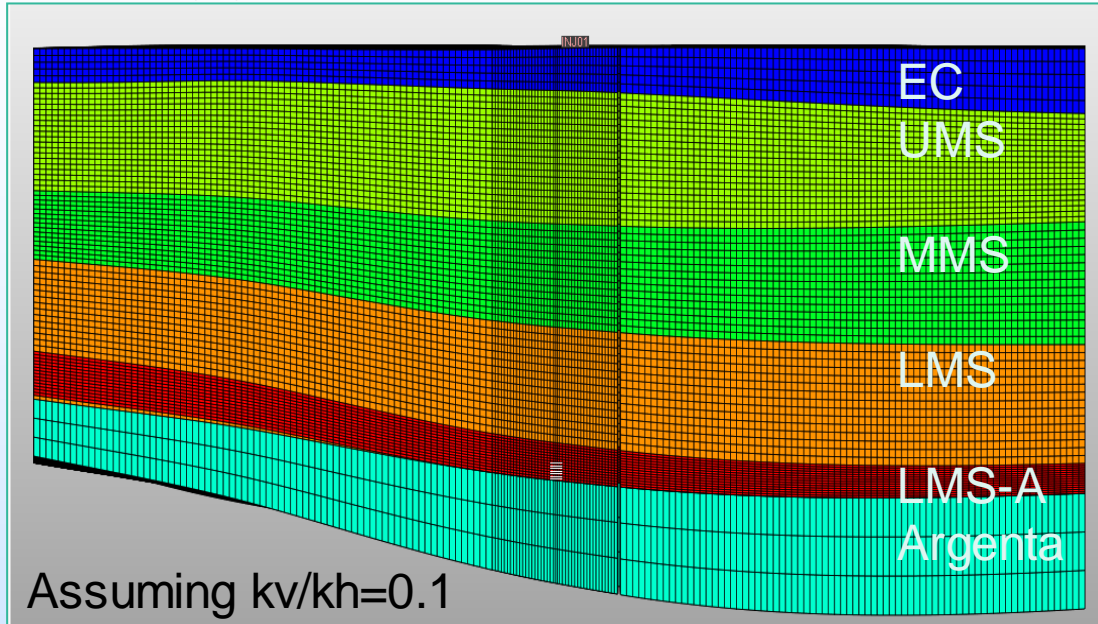


Risk Level	Description	# of Wells within 15 mi radius
Level 1	High risk	1
Level 2	Medium risk	1
Level 3	Low risk	149



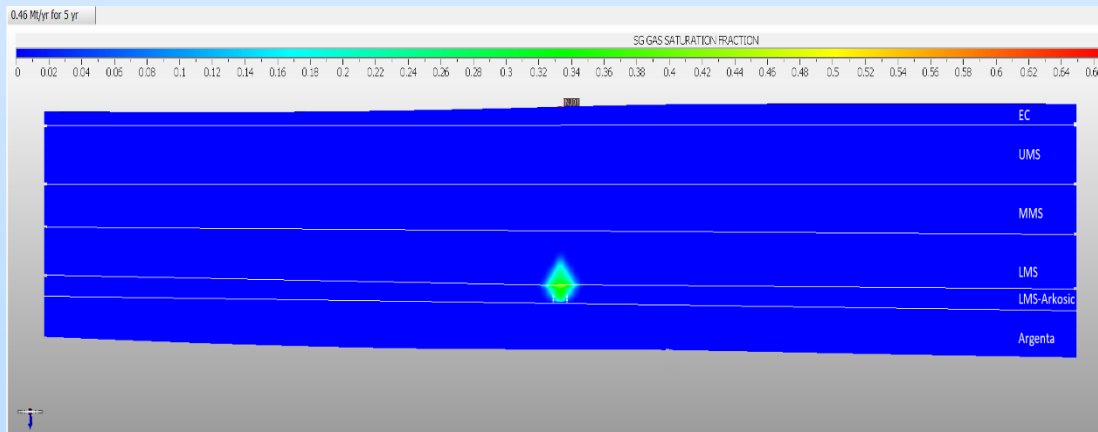
# Prelim One Earth Geocellular model

Cell averaging 2000 ft x 2000 ft x 35 ft, 2796 ft thick at well



Homogeneous model based on Hinton #7

Unit	Porosity, %	Permeability, mD
Eau Claire	9.7	0.1
Upper MS	11.1	7.43
Middle MS	9.4	2.3
Lower MS	14.3	35
LMS Arkosic	20.5	84
Argenta	13.4	0.85



CO<sub>2</sub> plume at 5 years:

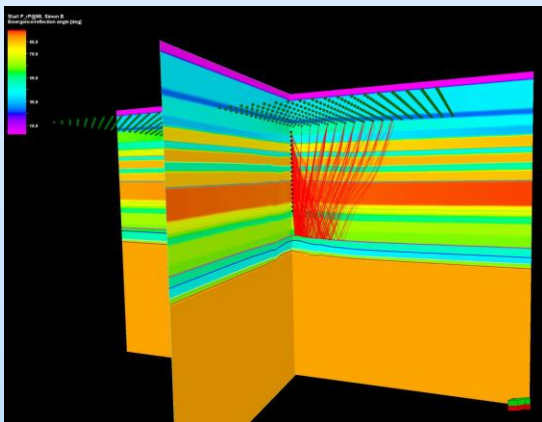
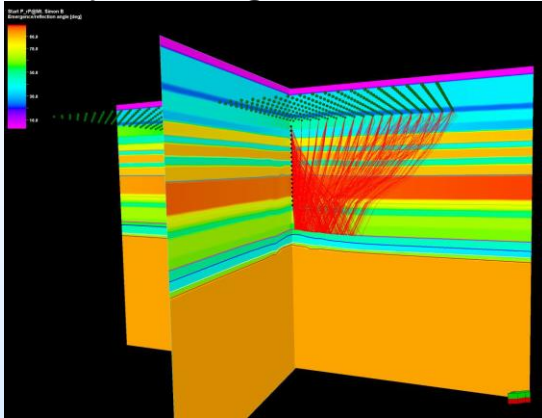
0.46 Mt/yr: 2000 ft (0.38 mi) in radius, 560 ft in height

2 Mt/yr: 3500 ft (0.66 mi) in radius, 761 ft in height

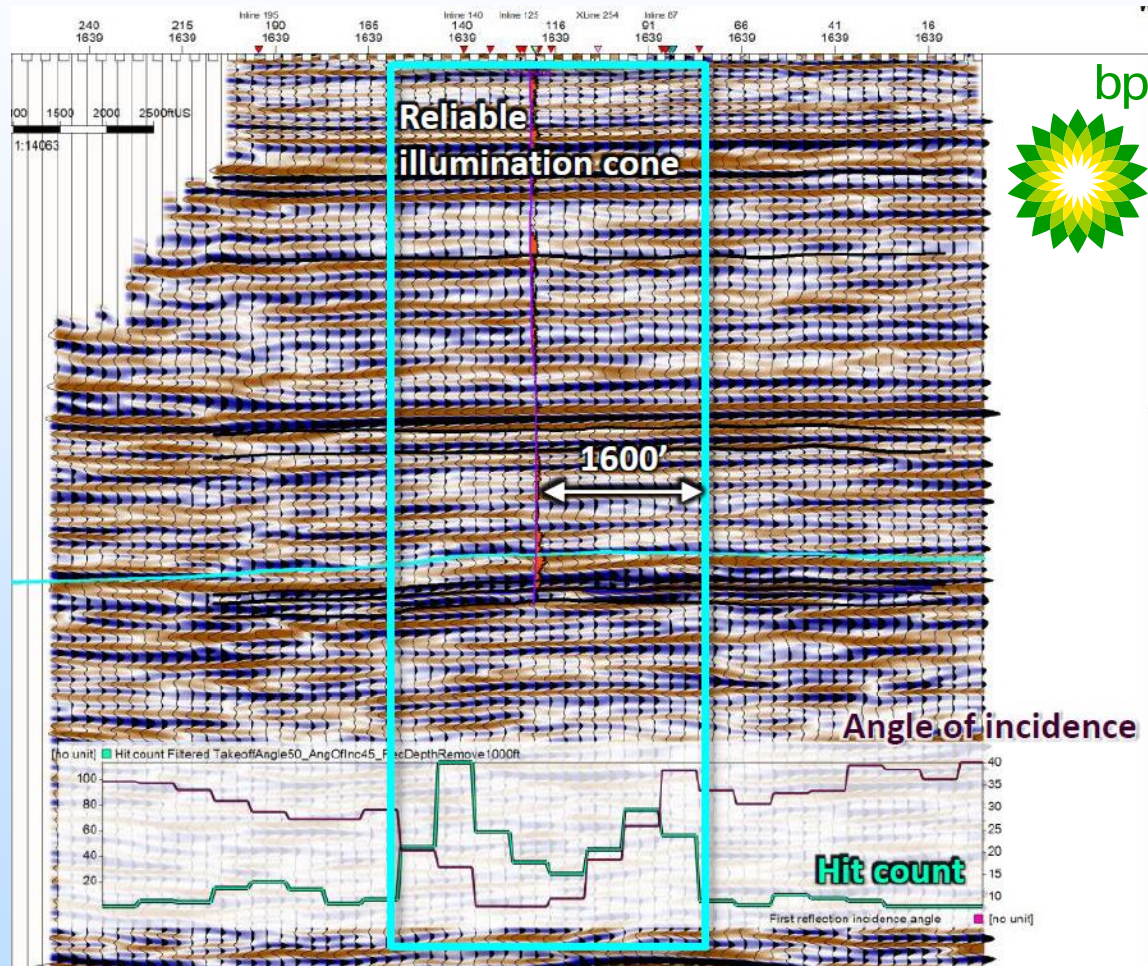


# Evaluation of DAS for plume imaging

## Ray tracing

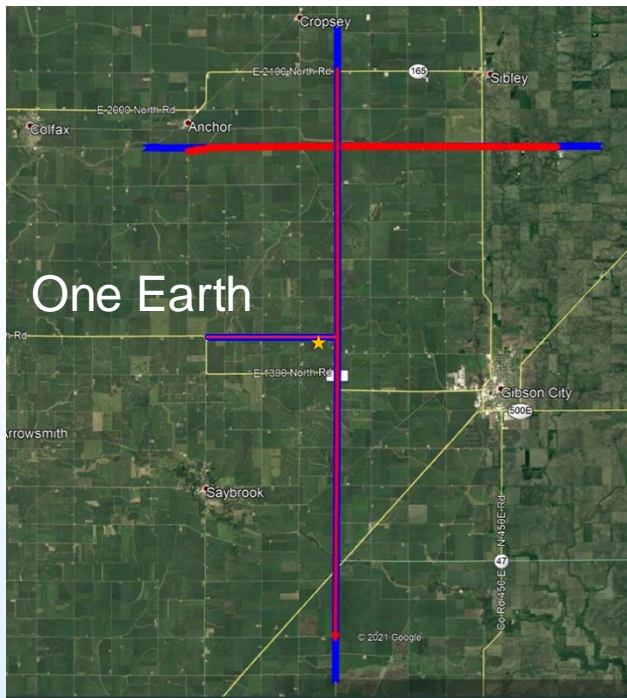


Successive filtering of rays based on reflection and intersecting angles on DAS

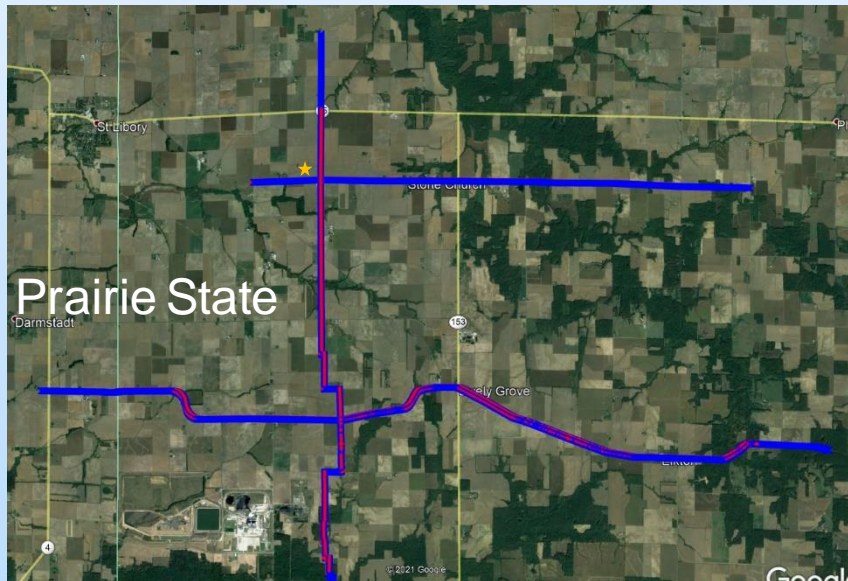


# 2D Seismic

~25 miles at each site

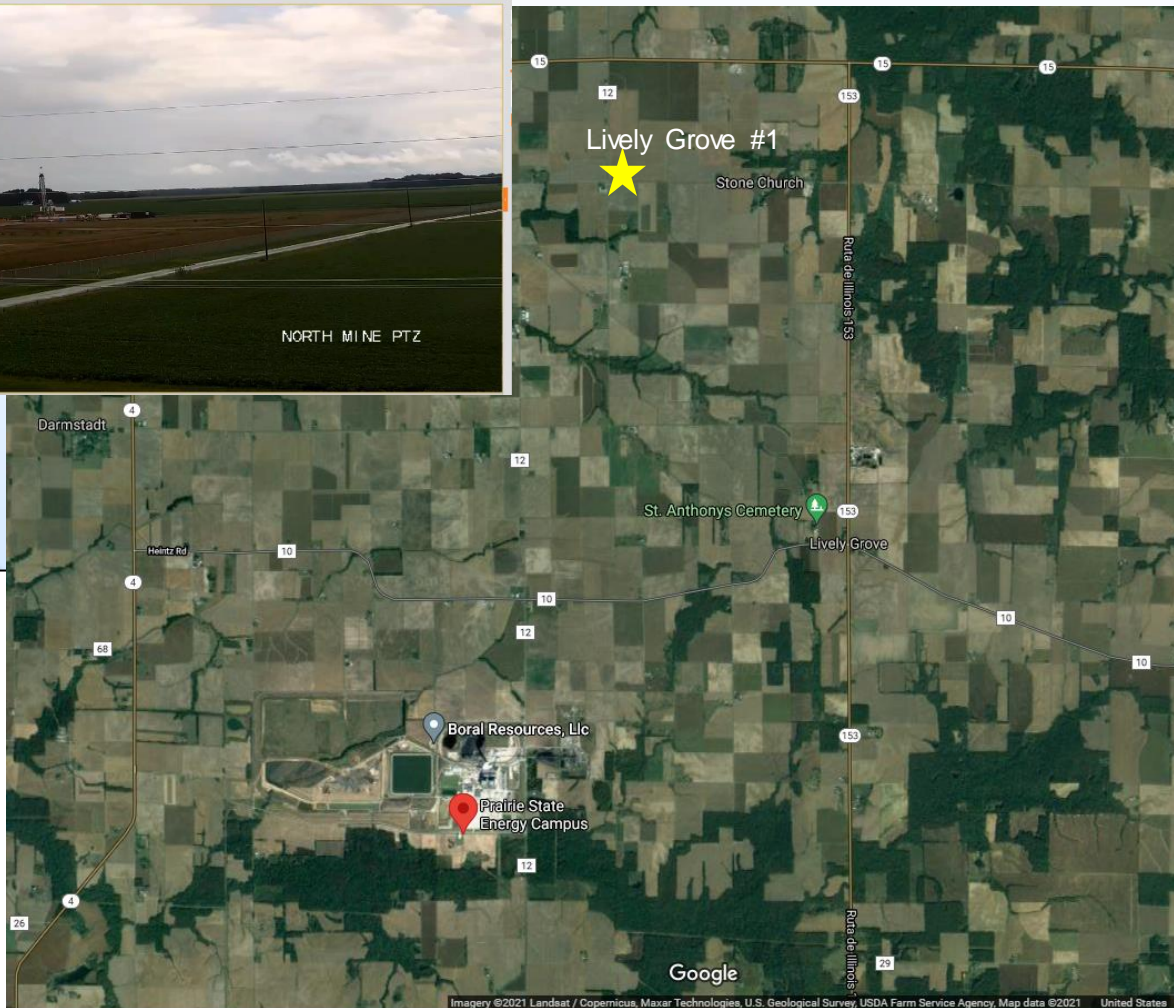


<b>Source Type</b>	<b>Vibroseis: ~60,000 lb peak force per vibe</b>
<b>Number of Vibrators per VP</b>	2-each
<b>Source Spacing</b>	80-feet
<b>Sweeps</b>	2-minimum per station
<b>Sweep Design</b>	2-100 Hz Linear
<b>Sweep Length</b>	16-second
<b>Record Length</b>	5-second
<b>Receiver Spacing</b>	20-feet
<b>Receiver Sampling</b>	2-millisecond
<b>Receiver Type</b>	STRYDE Nodal 150 g 1C 1-125 Hz with 28-day memory
<b>Tail Spread</b>	~6,000-feet
<b>PPV Monitoring</b>	Yes – Near surface infrastructure

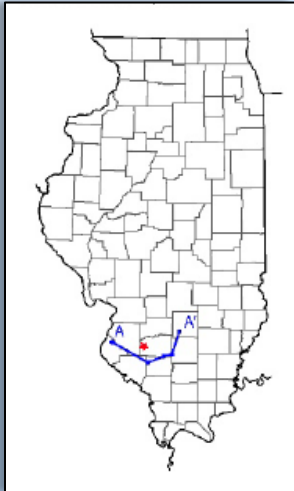




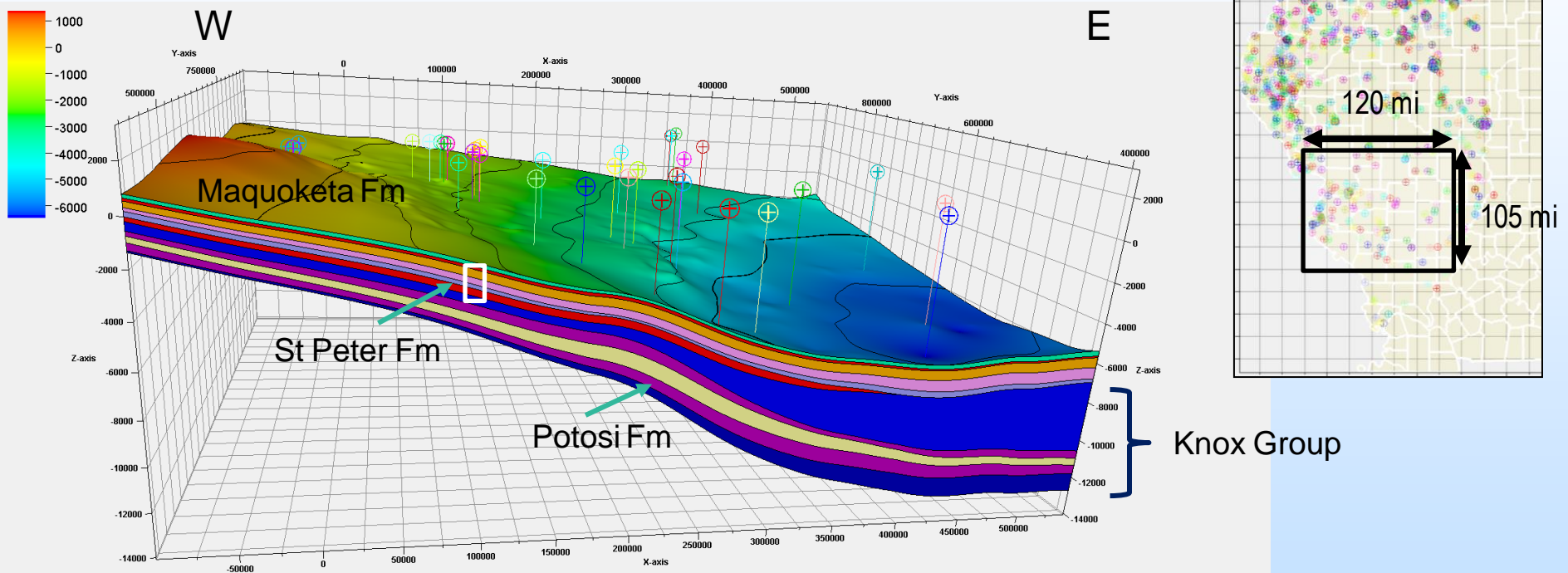
# Prairie State Storage Site



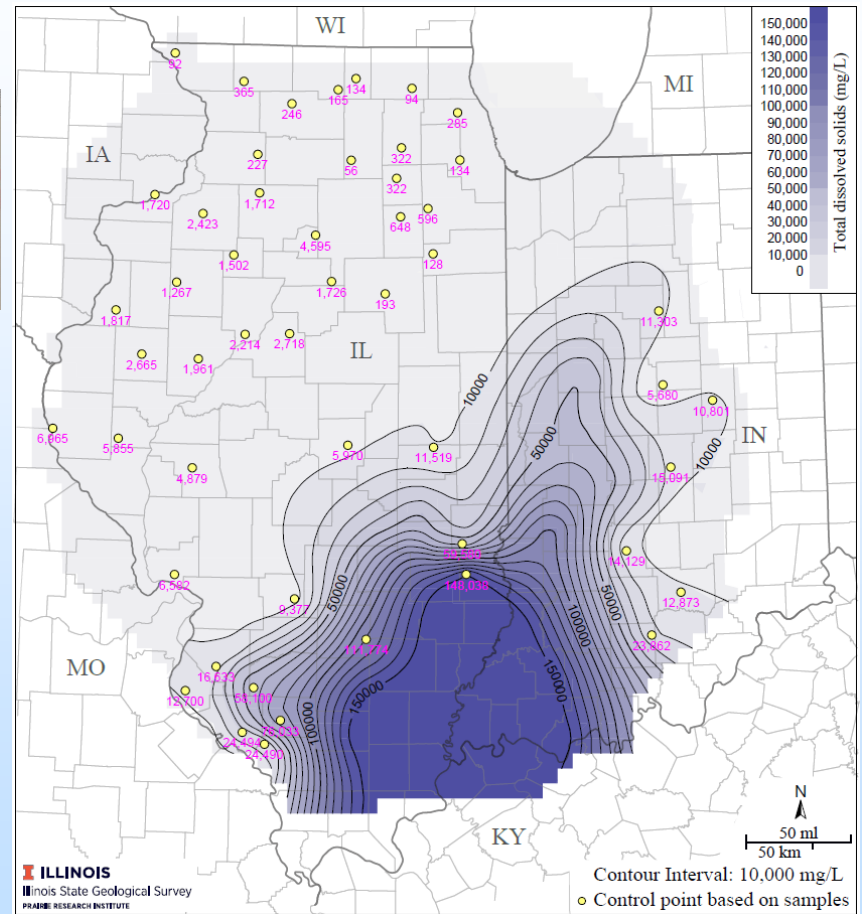
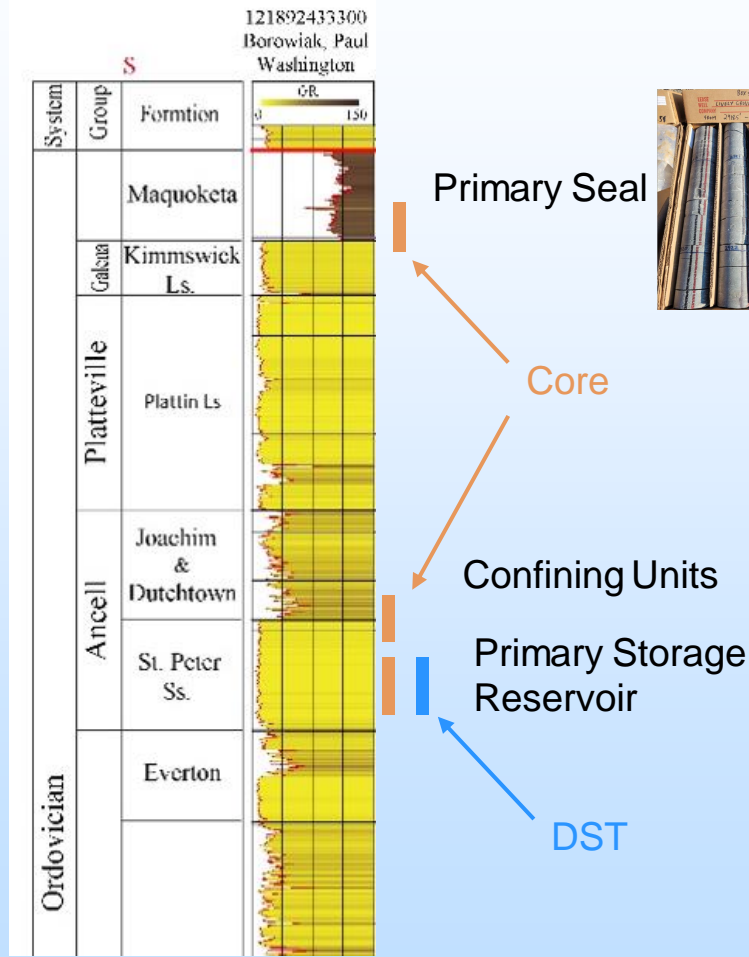
- Capture FEED study
- + 6Mta CO<sub>2</sub>
- Rural Setting
- Lively Grove #1 test well site ~ 6 miles north of plant



# Regional Stratigraphic Framework



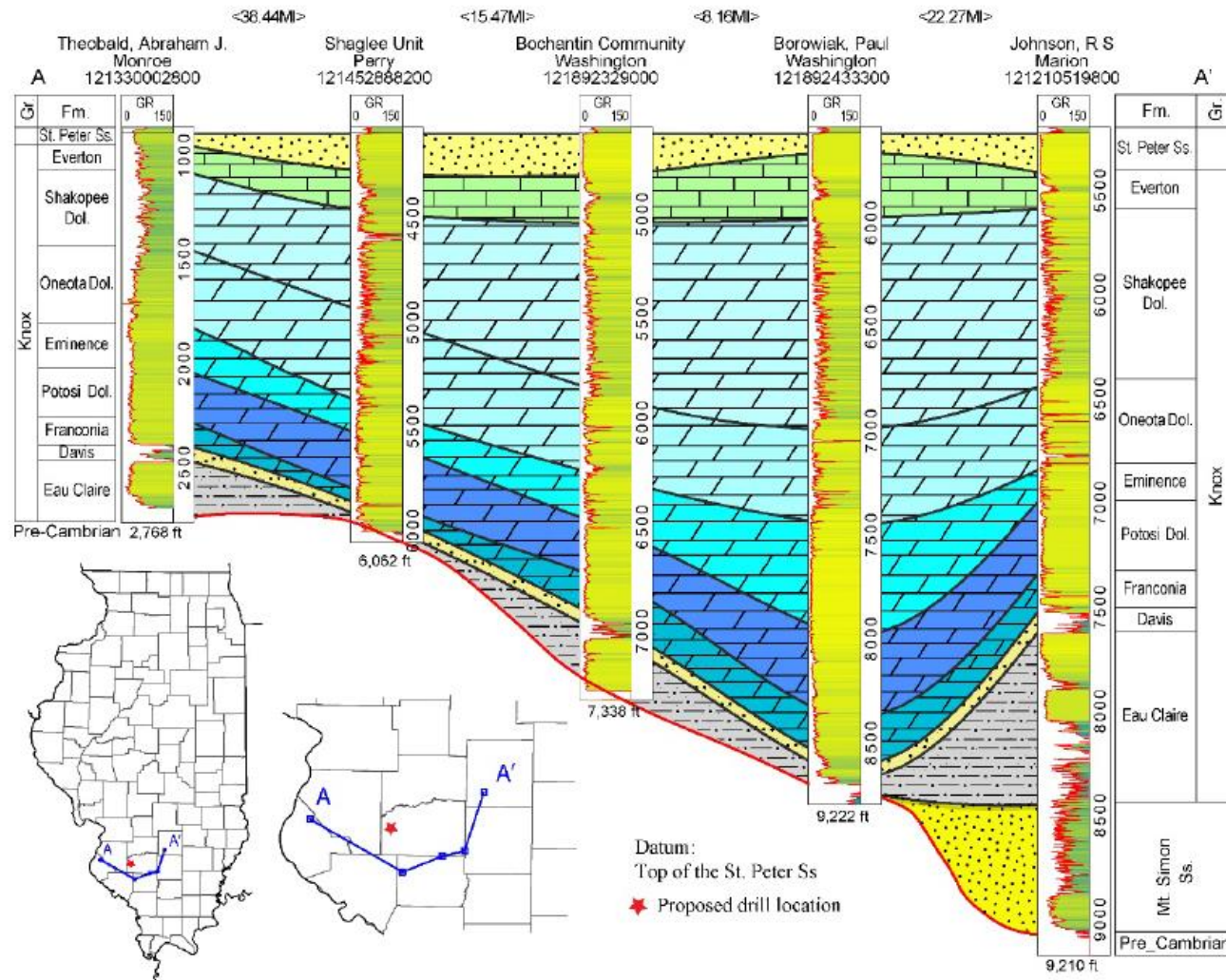
# St Peter Storage Complex



TDS in St Peter



# Prairie State Characterization

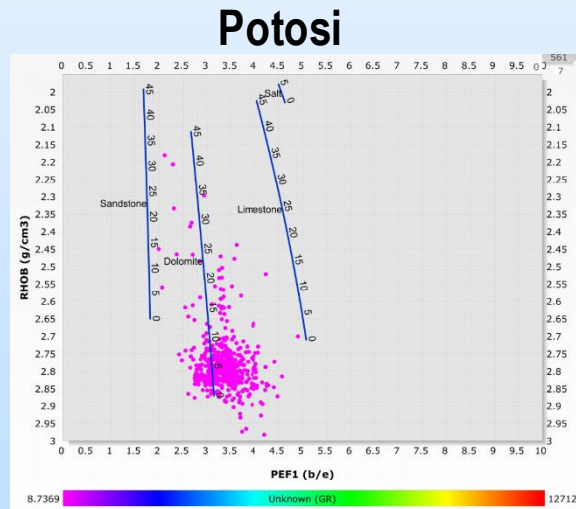




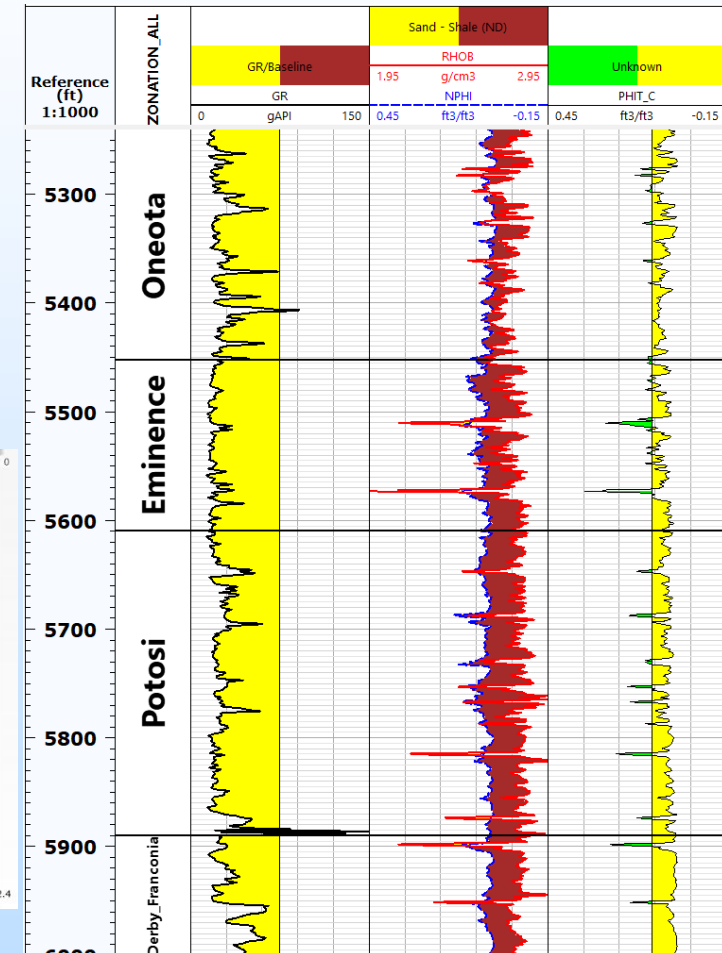
# Potosi Dolostone (2ry target)

## Thickness and porosity range

Well	Formation	Gross (ft)	Net (ft) Cutoff: 10% Porosity
121452888200	Eminence	157	32.5
121452888200	Potosi	280.33	22



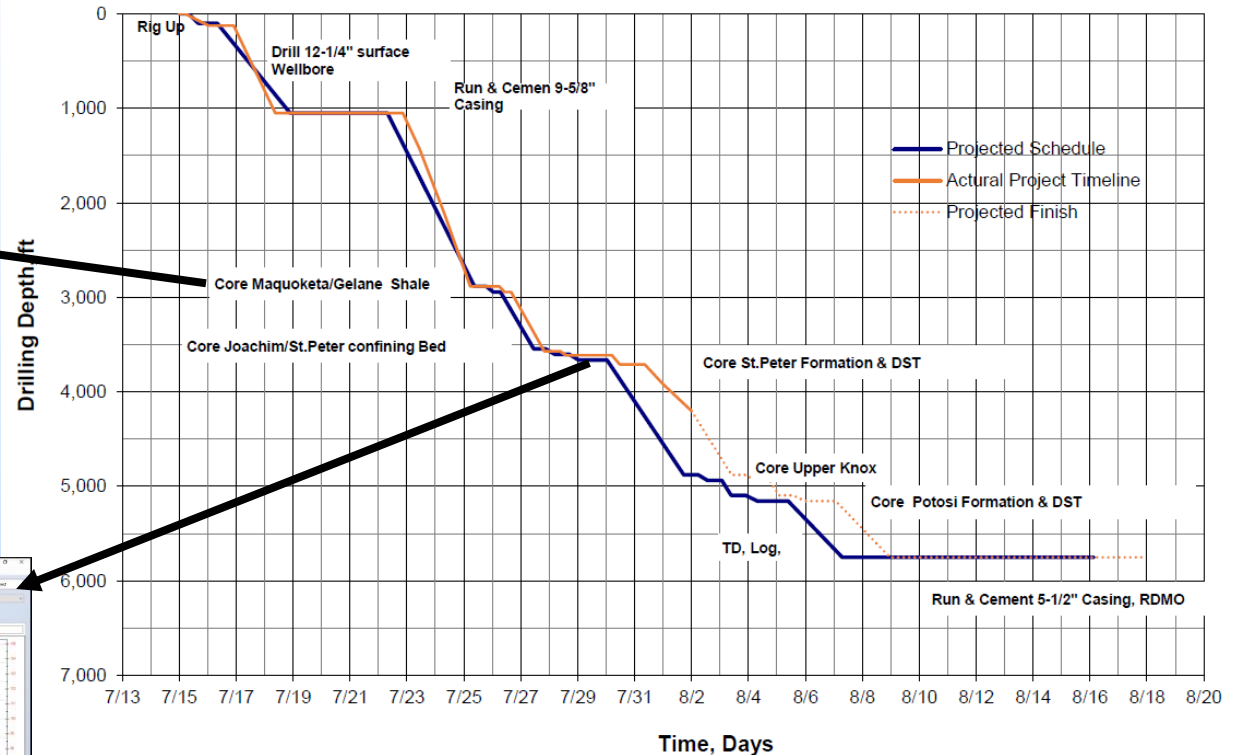
## Shaglee Unit



# Lively Grove #1



Prairie State Generating Company- Lively Grove Well #1 Proposed Drilling Timeline



# CO<sub>2</sub> Capture Assessment

## Full-Scale FEED Study For a 816 MWe Capture Plant at the Prairie State Generating Company Using Mitsubishi Heavy Industries of America Technology



DE-FE0031841 / Pittsburgh, PA / November 13, 2019

Kevin C O'Brien

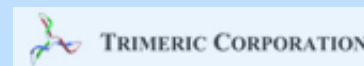
Director, Illinois Sustainable Technology Center and Illinois State Water Survey



- The PSGC plant was commissioned in 2012 and uses pulverized coal and super critical technology to run at high temperatures and pressures.
- Two 800-megawatt power units produce over 12 million tons of CO<sub>2</sub> annually.
- Capture of this CO<sub>2</sub> will be based on the KM CDR Process™ CO<sub>2</sub> capture technology from Mitsubishi Heavy Industries (MHI).



- OEE produces ethanol and approximately 458,000 tons/yr of relatively pure CO<sub>2</sub> byproduct.
- An engineering Pre-FEED study for capture at OEE is being conducted
- Trimeric and AECOM are leading this effort



# Class VI submittals

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- *Site Characterization data:*
- *Area of Review (AoR) and Corrective Action Plan:*
- *Injection Well Construction Plan:*
- *Plans for Pre-Operational Testing:*
- *Proposed Injection Well Operations Plan:*
- *Proposed Monitoring Plan:*
- *Proposed Mechanical Integrity Testing (MIT) Plan:*
- *Proposed Injection Well Plugging Plan:*
- *Post-Injection Site Care, and Site Closure Plan (PISC):*
- *Emergency and Remedial Response Plan (ERRP):*

# Accomplishments to Date

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- Submitted EIV and are addressing comments to draft
- Pre-drilling site characterization (incl prelim models)
- Legacy well risk database and identification
- Drilling well: Lively Grove #1
- Submitted permit to Illinois DNR for well at One Earth
- 2D seismic surveys permitted (acquisition to start August 16)
- Class VI permit writing in progress
- Process flow documents for capture at One Earth Energy
- Coordinating with FEED study at Prairie State

# Synergy Opportunities

- DE-FE0031841 is conducting a FEED study for capture at the Prairie State Generating Station that directly links with the CarbonSAFE Illinois Storage Corridor project
- Work performed under CarbonSAFE projects FE0029831 (Macon County) and FE0031626 (Wabash) are providing contributions to geological characterization in the Corridor region
- NETL researchers are collecting seismic data and water samples



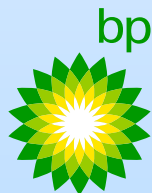


# Project Summary

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- Environmental Impact Volumes in revision
- Lively Grove #1 being drilled
- One Earth #1 to be drilled in fall 2021
- 2D Seismic surveys permitted and will start in mid-August
- Data Analyses and Modeling being integrated into Class VI permit templates
- Risk Assessment ongoing
- Capture Assessment at One Earth in progress

# Project Team



# Appendix

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- These slides will not be discussed during the presentation, **but are mandatory.**

# Benefit to the Program

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- CarbonSAFE Program goals being addressed:
  - Identify & characterize geological storage complexes to store > 50 million tonnes CO<sub>2</sub> within 30 years, and;
  - accelerate deployment of CCUS at commercial scale including understanding of how to safely, efficiently and cost effectively characterize and permit project sites.
- Project benefits.
  - Characterization will establish storage resources at 2 specific sites and have broader regional implications
  - Provide basis for development of storage hub(s)
  - Work will provide leadership for other industrial/energy sources and initiate further development in the region and elsewhere
  - Linkage with capture program

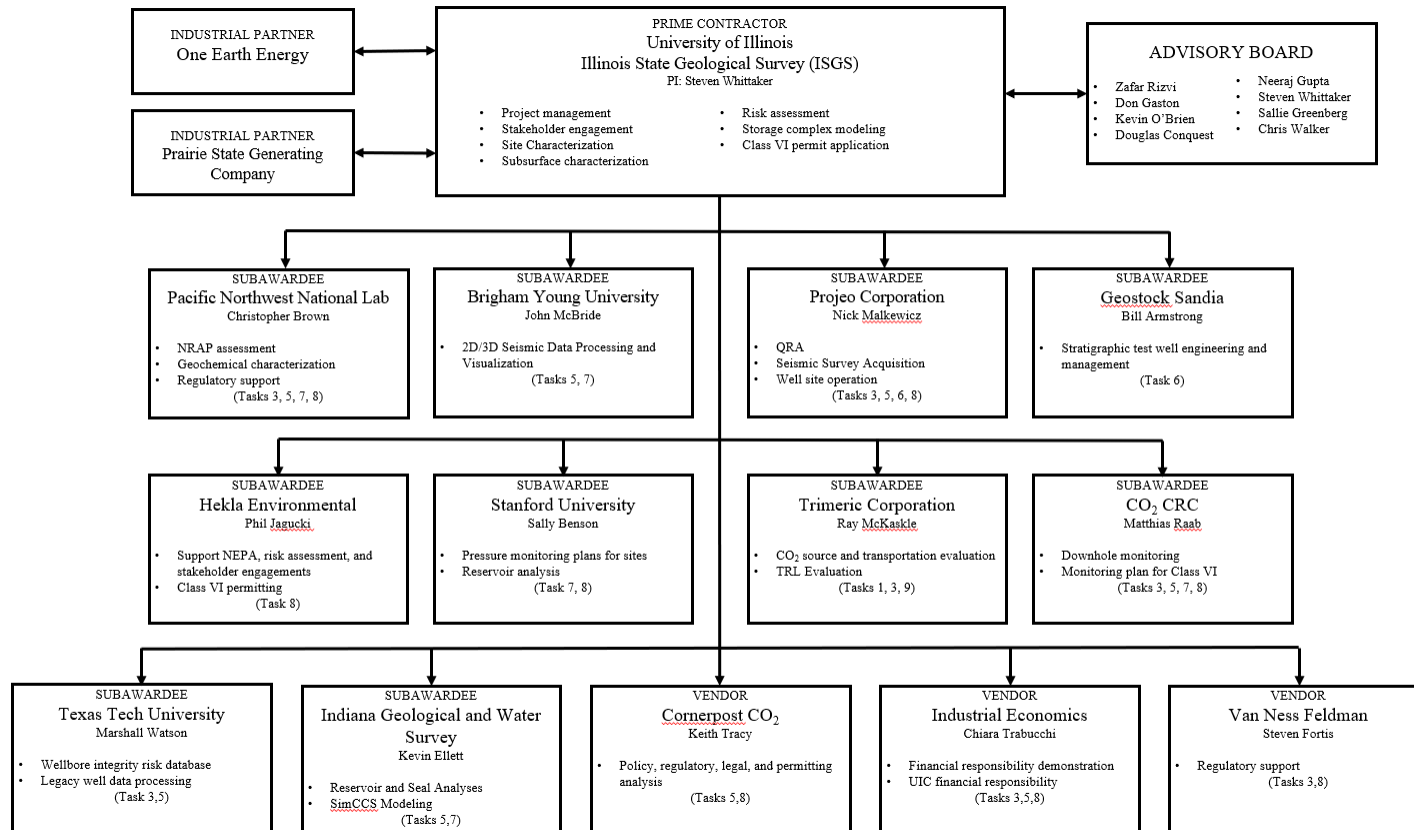
# Project Overview

## Goals and Objectives

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- Illinois Storage Corridor Objectives
  - Mature and prove CCS at commercial scale by performing subsurface characterization and related work to enable submission of 2 Class VI permit applications, and gain approval for construction of CO<sub>2</sub> injection wells at 2 sites in different storage complexes.
- CarbonSAFE Phase III program objectives:
  - acquisition, analysis and development of information to characterize a storage complex and demonstrate storage resources for commercial volumes of CO<sub>2</sub>.
  - identification of a storage site(s) within the storage complex,
  - preparation and submission of an Underground Injection Control (UIC) Class VI permit to construct

# Organization Chart





# Gantt Chart

Table 6. Gantt Chart with Team Responsibilities by Task. Letters refers to milestones in Table 3.				Budget Period 1												Budget Period 2																				Subawardees												Vendors			
				2020		2021				2022				2023																																					
#	Task Name	Start	End	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	ISGS	UIUC	PNNL	BYU	Projeo	Geostock	Hekla	CO2 CRC	Stanford	Trimeric	Texas Tech	IGWS	Industrial Economics	Cornerpost	Van Ness	Feldman																				
1.0 Project Management and Planning																																																			
1.1	Project Management Plan	10/01/2020	09/30/2023	A												X										X																									
1.2	Data Management Plan	10/01/2020	09/30/2023													X									X																										
1.3	Technology Maturation Plan	10/01/2020	09/30/2022																																																
1.4	Manage All Project Activities, Objectives, and Milestones	10/01/2020	09/30/2023	B												X																																			
1.5	Knowledge Sharing	10/01/2020	09/30/2023													X																																			
1.6	Communications	10/01/2020	09/30/2023													X																																			
2.0 National Environmental Protection Act (NEPA)																																																			
2.1	Preparation and Submission of an Environmental Information Volume (EIV)	10/01/2020	03/31/2021														X																																		
2.2	Preparation and Submission of NEPA Documentation	10/01/2020	09/30/2021																	X																															
3.0 Risk Assessment																																																			
3.1	Quantitative Risk Assessment	10/01/2020	09/30/2023													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																			
3.2	NRAP Toolkit Assessment	10/01/2020	03/31/2023													X		X						X																											
4.0 Stakeholder Engagement and Public Outreach																																																			
4.1	Stakeholder Analysis and Engagement Plan	10/01/2020	09/30/2022				C									X																																			
4.2	Conduct Stakeholder Engagement and Public Outreach	07/01/2022	09/30/2023													X																																			
5.0 Site Characterization																																																			
5.1	Pre-Drilling Site Assessment	10/01/2020	03/31/2021		D											X			X	X								X																							
5.2	Obtain Permits for Field-based Characterization Activities	10/01/2020	06/30/2021			E										X			X	X																															
5.3	2S and 3D Seismic Surveys	10/01/2020	03/31/2022				F									X			X	X																															
5.4	Analyses of Site Data for Class VI Permit Requirements	10/01/2020	09/30/2022													X	X	X	X	X			X	X		X																									
5.5	Policy, Regulatory, Legal, and Permitting Characteristics	10/01/2020	09/30/2022													X												X	X	X																					

# Gantt Chart (cont.)

Table 6. Gantt Chart with Team Responsibilities by Task. Letters refers to milestones in Table 3.				Budget Period 1								Budget Period 2																				
				2020		2021				2022				2023				Subawardees												Vendors		
		Start	End	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	ISGS	UIUC	PNNL	BYU	Projeo	Geostock	Hekla	CO2 CRC	Stanford	Trimeric	Texas Tech	IGWS	Industrial Economics	Cornerpost	Van Ness	Feldman	
#	Task Name																															
6.0 Drilling and Well Testing																																
6.1	Design Well Drilling Program	10/01/2020	06/30/2022													X				X	X											
6.2	Drill and Construct Stratigraphic Test Well	07/01/2021	03/31/2022					G												X	X											
6.3	Well Testing and Data Collection	10/01/2021	09/30/2022													X	X			X	X											
7.0 Storage Site Modeling																																
7.1	Development of Conceptual and Static Model	01/01/2021	09/30/2022			H										X		X						X				X				
7.2	Development of Dynamic Reservoir Model	04/01/2022	09/30/2022													X	X	X					X	X				X				
7.3	Development of Geomechanical Model	04/01/2022	09/30/2022													X	X	X						X			X					
7.4	Model Calibration and Updating	01/01/2021	09/30/2022													X	X	X						X								
8.0 UIC Class VI Permitting																																
8.1	Pre-Permitting Activities	10/01/2020	06/30/2022													X						X						X	X	X	X	
8.2	UIC Class VI Permit Application	04/01/2022	09/30/2022										I			X				X							X	X	X	X		
8.3	Permit Application Revisions	10/01/2022	09/30/2023													X						X					X	X	X	X		
9.0 Carbon Capture Assessment																																
9.1	Identification of CO2 Sources and Capture Technology	10/01/2020	03/31/2021																						X							
9.2	Conduct Pre-Feasibility Study of Capture System	04/01/2021	09/30/2022																						X							

# Bibliography

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- No peer reviewed publications generated from the project to date.